the catalogue number, the magnitude, the south polar distance, the C.P.D. number, and the exact precessional corrections for each star.

The Climatology of 1903.—As in former years, the meteorologist of the Juvisy Observatory, M. J. Loisel, has published the detailed results of the observations made at that observatory during the past year in the *Bulletin de la Société astronomique de France* (February).

The results are graphically depicted by a series of curves, one set of which shows and compares the rainfall, the direction of the wind, the temperature, pressure and hygrometric state of the atmosphere, the number of hours of sunshine, the state of the sky, and the declination and phase of the moon for each day. A set of tables comparing each of the four seasons with the corresponding season for each year since 1886 shows that, on the whole, the winter was warm, the spring dry, the summer cold, and the autumn warm during 1903 as compared with the mean conditions. The curve depicting the amount of the effective insolation shows that during 1903 there were two maxima, one in May the other in July, instead of one in July as shown on the curve for 1902. A comparison of the total solar radiations observed during 1902 and 1903 gives 146,115 and 140,175 calories respectively.

Meridian-circle Observations at the Lick Observatory.—The results of the meridian-circle observations made at the Lick Observatory during the period August, 1896, to March, 1901, by Mr. Richard H. Tucker have just been published in one volume (*Publications* of the Lick Observatory, vol. vi., 1903). The results include about 11,700 full observations, and 2700 observations in one coordinate only, for the determination of 4500 stars.

The first part of the work consists of the results of the observations for declination of 361 latitude stars previously observed by Prof. Doolittle at South Bethlehem, Pa, and includes 107 stars from the "Standard Catalogue" of Lewis Boss. The resulting declinations are compared, where the stars are common to the catalogues, with those given in Boss's catalogue and the Berliner Jahrbuch.

The second part of the volume is devoted to the observations of 21 circumpolar stars, all above declination +82°, in compliance with a request of Dr. Auwers. Part iii. gives the results of the observations of 50 zodiacal stars, made during 1898 at the request of Sir David Gill to furnish places for his heliometer measures of the major planets.

The volume also contains a description of the observations, and their reduction and final results, of 3088 southern stars contained in the catalogue observed by Piazzi, at Palermo, during the period 1792 to 1813.

The stars in the first and second lists of the Astrophotographic Conference, of comparison stars for Eros, were observed at Lick, and the results are given and discussed in the fifth section of the volume.

The observations are concluded with the results obtained in some miscellaneous observations made during the period 1897 to 1901. These include 49 comparison stars for various purposes, 20 proper-motion stars observed for Prof. J. G. Porter, of Cincinnati, and several meridian-circle observations of Eros, Nova Persei, and two comets.

M. BLONDLOT'S *n*-RAY EXPERIMENTS.[1]

In his experiments on the rapidity of propagation of the Röntgen rays, the French academician, M. R. Blondlot, discovered a new kind of rays, which he called *n*-rays, after the place Nancy, in which they were first observed.[2] These rays are said to be emitted by an Auer burner, or better still by a Nernst lamp of 200 watt-power. Like the Röntgen rays, they are said to pass through aluminium with ease, but on the other hand to be absorbed by the slightest film of water, like the longer heat-waves. Although they are stated to be absorbed by cold platinum, they readily pierce red-hot platinum.

Blondlot has recently found that these *n*-rays are emitted by the wire of the Nernst lamp even after this has been extinguished for several hours, and that, moreover, flints which have been exposed to the sun's rays have a distinct effect in the sense of the *n*-rays.

In all these observations of Blondlot the action of the *n*-rays consists in general of a brightening of a source of light under these rays, or rather of a darkening when the rays are cut off by interposing either the hand or a lead screen between the source of light and the source of the *n*-rays. The analysing source of light may be a small spark, a bluish flame, a phosphorescent surface, a dark platinum plate at dull red heat, or the surface of paper feebly illumined by a source of light. The dimensions of all these analysing sources of light are very small (the illumined paper, for instance, being 2 mm. by 16 mm. in size), and the observation is carried on in a dark room.

Although the change in brightness is said to be considerable, neither Blondlot (*C. R.*, cxxxvii., 167, 1903), Rubens (Ebenda) nor others (*Phys. Zeitsch.*, iv., 732 and 733, 1903) have hitherto succeeded in demonstrating objectively the corresponding transformation of energy. At the same time the phenomena observed subjectively by Blondlot could not be perceived by Rubens and others in repeating the latest experiments with slightly illuminated or phosphorescent surfaces.

Without wishing, for the present, to dispute the objective existence of these *n*-rays, I should like in what follows to bring forward the fact that a whole set of Blondlot's experiments may be almost exactly imitated in their effects *without employing any source of illumination whatever,* and that the changes in form, brightness, and colour respectively of the analysing luminous surface observed by Blondlot under a stream of rays, and the interception of a diaphragm (Abblendung) may be referred to processes taking place in the eye itself, and, in fact, to the *contest between the rods and cones of the retina in seeing in the dark.*

It has been known for some time that the layer of rods and cones in the retina is the structure which is sensitive to light whereby this form of energy, from without, is transformed into nerve-stimulation. While, however, experiments on sharpness of vision have led to the assumption that the power of vision is due to the agency of the cones alone, the almost identical anatomical structure of the rods admits of the conclusion that they also play their part in vision. But on the ground of more recent physiological researches on vision in dim light, and the influence of the visual purple contained in the rods on colour-perception, we have been enabled to distinguish, more and more clearly, the respective modes of action of these two elements of the retina and to ascribe to them their different functions. A. König[1] had already ascribed to the rods the colourless vision of the totally colour blind in every degree of brightness, the non-perception of colour in a very dim light of those otherwise able to perceive colours, and the perception of blue. J. v. Kries[2] went further, and disposed of the still existing difficulties and contradictions by putting forward the hypothesis that the cones form our colour-perceiving "light apparatus" ("Hellapparat") and the rods our totally colour blind "dark apparatus" ("Dunkelapparat"). According to this theory of Kries the cones render vision possible in a very bright light, and their stimulation by light-waves arouses in the brain the perception of colour, while the purple containing rods are totally colour blind, and only come into action in a very dim light, and are endowed with the property of considerably increasing their sensitiveness in the dark. These properties of the rods are called by Kries "adaptability to the darkness" (Dunkeladaptation). Before the cones perceive coloured light, the rods bring about in the brain the impression of colourless light.

We know from the anatomy of the eye[3] that the fovea centralis contains cones only and no rods, and that the rest of the retina has rods as well as cones, the former predominating towards the periphery, and it is also well known that the fovea centralis is the special point of vision when looking at an object and fixing our eyes upon it. *Hence it follows that in gazing at an object, i.e. direct vision (foveal), the rods are excluded, and it is only in indirect vision (peripheral) that they come into action.* Thus then in dim light these two elements enter into a sharp contest which, if the light is dim enough, results in favour of the colour-blind rods, so that everything then resolves itself into greys, *i.e.* colourless shades of light.

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[1] Translation of "Notes in Elucidation of the Most Recent Researches of M. R. Blondlot on the *n*-Rays." By O. Lummer. Read at the sitting of the German Physical Society, November 27, 1903.

[2] R. Blondlot, "Sur de nouvelles actions produites par les rayons *n*; genéralisation des phénomènes précédemment observés" (*C. R.*, cxxxvii., 684, 1903). "Sur l'emmagasinement des rayons *n* par certains corps" (*C. R.*, cxxxvii., 729, 1903).

[1] "Über den menschlichen Sehpurpur und seine Bedeutung beim Sehen (*Sitzber.* d. Berl. Akad d. Wissensch., S. 577, 1894).

[2] ' Über die Funktion der Netzhautstänchen (*Zeitsch.* f. Psych. u. Physiol. d. Sinnesorgane, ix., 81–123, 1894).

[3] R. Greef, "Die mikroskopische Anatomie des Sehnerven und der Netzhaut." Aus dem "Handbuch der Augenheilkunde" von Graefe u. Samisch. 2 Aufl., I. Bd., V. Kap. (Berlin, 1901.)

By the help of this theory one gets a natural explanation of phenomena hitherto unexplained, as, for example, Purkinje's phenomenon, the change of position of the "neutral point" in the spectrum as light decreases in the case of those who confound red with green, and the dependence of colour identification on the absolute intensity of light. In my work "Grauglut und Rotglut" I was able to show[1] that the remarkable "shadow-like" (gespensterhaft) appearance of the grey and red glow can be explained by attributing to the two light-perceiving elements the part assigned to them by v. Kries.

If in a dark room we observe the gradual rise in temperature of a body from that of the room up to glowing temperature, then, according to my view, the eye perceives two sudden changes or "leaps," first from dark to shadowy grey ("grey glow"), and later from grey glow to coloured glow (red glow). In each case the "leap" arises from stepping over the threshold of stimulation of the optic nerve, but the efficient organs are not the same in the two cases; the grey glow corresponds to the threshold of stimulation of the rods, the red glow to the threshold of stimulation of the cones. *Accordingly we must conceive of the grey glow as a sensation of the retinal rods and of the red glow as the sensation of the retinal cones.*

The "shadow-like" character of the rod-vision is not apparent until we observe a sufficiently small surface the retinal image of which does not exceed in area that of the spot of clearest vision, *i.e.* the fovea centralis, and the increase of brightness of which we follow in the dark from zero upwards. For this purpose it is best to make use of a platinum plate brought to a glow by means of electricity and limited by a diaphragm, the development of light thus being observed in the dark by a well-rested eye. When the platinum plate has reached a temperature of about 400° C., at first only the rods of the eye searching in the dark are stimulated, and the perception of colourless light (grey glow) is aroused in the brain.

Being accustomed to gaze at what sends us light we turn our eyes in the direction from which we believe the light rays come. As, however, the cones have not yet been stimulated, the fovea centralis sends no message of light to the brain; accordingly we cannot see the spot gazed at. Thereby we are confronted by the remarkable fact that we see something which we are not gazing at, whilst it becomes invisible when we wish to fix our eyes upon it. And as we can see nothing by direct vision, we involuntarily move our eyes away, whereby the rays again fall on extra-foveal retinal spots; we again receive the impression of light, and our search after the place from which the remarkable light comes begins over again. Thus there arises in us the impression of a light which darts to and fro, which is sometimes present, then again evades us, mocking us, like a will-o'-the-wisp. It is only when the brightness is of a sufficient intensity to stimulate the cones also and enable them to send a message of light to the brain that this unusual condition comes to an end, and then we see what we gaze at, just as we have been accustomed to do, and the thing seen no longer escapes the searching gaze.

In the case of glow this does not occur until the body has reached a temperature somewhat above 500° C.; not until then are the cones stimulated, and we then perceive colour as well as brightness, in other words, the "grey glow" is transformed into "red glow."

But at a still higher temperature (up to 700° C. and above) the rods enter into vigorous competition with the cones, and the light red colour seen in gazing at the platinum plate changes in indirect vision into a peculiar colourless white, the "rod white," while at the same time the brightness of the platinum plate increases considerably.

In some of Blondlot's experiments one finds oneself in precisely the same position as in the observation of the "shadowy vision" just described. One perceives a very small slightly luminous surface, *e.g.* a dull red glowing platinum plate, in the dark and fixes one's gaze upon it. Before bringing one's undivided attention to bear on it, it is seen by the extra-foveal parts of the retina, because the eye involuntarily endeavours to gather as much light as possible, thus consequently both rods and cones take part in the vision. As soon, however, as the lead screen or the hand is interposed between the source of illumination and the luminous platinum surface, the observer, in order to see the change in it, will fix his gaze as directly as possible on the platinum plate, thereby excluding the rods. The necessary consequence will be that the platinum plate will appear reddish and less bright, and the rod-white of the peripheral parts of the retina be lost. But this fixing of the gaze requires time and effort. The darkening and the red colouring observed will also require a certain amount of time, and as soon as the hand or the screen is removed the eye will return as quickly as possible to extra-foveal observation, in which it receives more light. After the removal of the screen, therefore, the brightness of the platinum plate increases, and provided the brightness of the luminous surface under observation is very dim, there will be an immediate diminution in the distinctness of the outlines on darkening it while the gaze is fixed on it, in fact, there will eventually be a complete disappearance of the platinum plate provided the energy sinks below the threshold of stimulation of the cones and the surface is small enough.

As a proof that the phenomena here described (which were not only observed by myself subjectively, but were produced in my lecture before a large audience) resemble to an extraordinary degree the more recent observations described by Blondlot, I will quote, word for word, two sentences from his article of November 2, 1903 (*C. R.*, cxxxvii., 685, 1903). After describing the order of procedure in the observation of a feebly illumined strip of paper, he goes on to say:—"If one now intercepts the rays by interposing a lead plate or the hand, one sees the small rectangle of paper grow dark to its contour and lose its distinctness; the removal of the screen causes the brightness and the distinctness to reappear, the light diffused by the strip of paper being then increased by the action of the *n*-rays."[1]

In the case in which Blondlot observes the transparently luminous paper mirrored on a needle and then illumines the needle with the *n*-rays, he describes the process in the following words:—"It was then easy to prove that the action of these rays strengthens the image, for if one succeeds in intercepting them, this image becomes dark and reddish. I have repeated this experiment with equal success by employing instead of the knitting-needle a plane bronze mirror."[2]

In this article it is also stated:—"All these actions of the *n*-rays on light require an appreciable time for their production and disappearance";[3] this is on a parallel with the appearances of grey and red glow during vision in the dark. The experiments described in this article do not deal with the behaviour of different substances under exposure to the *n*-rays. It is unnecessary to say that seeing in the dark can in no wise explain why some substances transmit the *n*-rays and others do not. But it may be asserted briefly that neither brightening, darkening, nor change in colour will take place if during the experiment with the above mentioned source of light one gazes continuously at the analysing luminous surface so that the image always falls on the fovea centralis and the cones alone come into action. As a matter of fact, Prof. Rubens, as he kindly informed me in answer to my question, took his observations in this way, and could perceive no brightening even when a very powerful Nernst lamp was employed. Moreover, this sustained gaze is always accompanied by great fatigue, for reasons already adduced, and especially so in observing a very feebly luminous surface of small area in a dark room. The sustained gaze at small bright objects, as is well known, is, in fact, the most effectual way of inducing hypnotic sleep.

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[1] O. Lummer, "Über Grauglut und Rotglut" (*Wied. Ann.*, lxii., 14–29, 1897; *Verh.* Phys. Ges. Berlin, xvi., 121–127, 1897).

[1] "Si maintenant on intercepte les rayons en interposant une lame de plomb ou la main, on voit le petit rectangle de papier s'assombrir, et ses contours perdre leur netteté; l'éloignement de l'écran fait reparaître l'éclat et la netteté; la lumière diffusée par la bande de papier est donc accrue par l'action des rayons *n*."

[2] "Il fut alors facile de constater que l'action de ces rayons renforce l'image, car si l'on vient à les intercepter, cette image s'assombrit et devient rougeâtre. J'ai répété cette expérience avec le même succès en employant, au lieu de l'aiguille à tricoter, un miroir plan en bronze."

[3] "Toutes ces actions des rayons *n* sur la lumière exigent un temps appréciable pour se produire et pour disparaitre."

But although one cannot imitate all M. Blondlot's experiments by purely subjective perceptual processes without employing some source of illumination, I have thought it advisable to direct attention to these more recent physiological discoveries, the more so as M. Blondlot pays no attention to them in any of his publications, and does not state with what visual apparatus one ought to observe, nor does he give warning of the illusions one may fall into in carrying out his experiments. But the foregoing statements will at least serve to remind all those who take the trouble to repeat M. Blondlot's experiments that in vision in the dark changes in brightness, form and colour may arise from a purely subjective source. These purely subjective changes, however, do not depend upon any optical illusion, but, like the "shadow-like" appearances of the "grey glow" and the "red glow," are brought into existence by the competition between the two elementary structures of the visual organ, and correspond to objective processes in the retina.

As soon as the phenomena observed by M. Blondlot shall have been incontestably proved by means of objective instruments of precision, these few remarks on the *n*-rays will be only of secondary importance.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—At a meeting held at The Museums, Cambridge, on February 8, Prof. Newton, F.R.S., being in the chair, it was decided to take steps to perpetuate the memory of the late Mr. J. S. Budgett. Since his return from his last expedition to Africa, Mr. Budgett had made some important observations on the material collected by him, but a large part of the valuable material which he gave his life to obtain was necessarily untouched by him. It is proposed that this should be worked out by some of his friends, and the results published, with the observations and drawings which he had himself made. The work would be edited by Prof. J. Graham Kerr, and suitably illustrated. It is also proposed, if the funds available are sufficient, to add to the volume a reprint of all Mr. Budgett's former writings, so that the volume will become a memorial of his life's work. Subscriptions towards the cost of preparing this volume should be sent to Mr. A. E. Shipley, Christ's College, Cambridge.

A VERBATIM report of the conference of teachers, held under the auspices of the London Technical Education Board on January 7–9, appears in the *London Technical Education Gazette*—the official circular of the Board—for January and February.

AT a joint meeting of the academical and university councils of Paris, some interesting remarks were made by M. Liard arising out of the recent changes according to which professors of secondary education were last year, for the first time, allowed to sit on juries for the baccalaureate. An opportunity has been given to these professors of expressing an opinion on the work submitted to them, and they all agree in considering that the subjects studied seem to appeal to the memory rather than to the faculties of observation, reflection and judgment.

THE Childhood Society, the object of which is the scientific study of the mental and physical conditions of children, has arranged a course of four public lectures to be given at the Sanitary Institute, commencing on Thursday, February 25. The lectures will be as follows:—"Some Elementary Aims in Education," by Mr. Hamilton Hall; "Protection of Feeble-minded Children during and after School Age," by Prof. W. A. Potts; "Physiology in the Curricula of Primary and Secondary Schools," by Dr. D. Sommerville; and "Child Punishments," by Dr. H. R. Jones.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 26, 1903.—"On the Distribution of Stress and Strain in the Cross-section of a Beam." By John **Morrow**, M.Sc. (Vict.), Lecturer in Engineering, University College, Bristol.

The author describes some experiments on the measurement of lateral or transverse strains in specimens of wrought and cast iron when subjected to bending. The instrument used for the determination of the displacements of the sides of a beam consists essentially of two cranked levers pivoted together. At one extremity these are in contact with the points on the specimen between which the change of length is required, while the relative motion of the other ends is measured optically by means of a fixed and a tilting mirror. This method of measurement allows of great precision and delicacy of reading. In this case the lateral displacements were observed to the nearest 1/400000 of a centimetre.

The beams used were about 3 cm. broad and 6·5 cm. deep, and they were supported on knife-edges about 90 cm. apart. Measurements of the transverse extensions or contractions were made at seven different points in the depth of the beam, while the applied bending couple was increased by definite increments of about 9347 kg.cm. each.

The actual strains proved to be appreciably smaller than those which might be expected from the Bernoulli-Eulerian theory.

The relations obtaining between the lateral and linear strains, for the materials in question, were found from independent experiments in direct tension and compression, and by a comparison of these with the transverse strains in the beams, the amount and distribution of the stresses over the cross-sections of the beams were inferred.

The results for cast iron specimens showed that, at the lower loads, the longitudinal stress varies as the distance from the neutral axis, but that in amount it is less than would be expected from theoretical considerations. As the load is increased, however, the strain diagrams become more and more curved in the direction of a decreasing strain at greater distances from the neutral axis, and this is accompanied by a displacement of the neutral surface towards the compression side of the beam.

It is well known that the existing theory does not give a completely satisfactory account of the actions in a beam. This paper is therefore important, not only for its own results, but because it opens up a new method of experimentally approaching this and the allied subjects, and so facilitates further research on similar lines.

February 4.—"Conjugation of Resting Nuclei in an Epithelioma of the Mouse." By E. F. **Bashford**, M.D., and J. A. **Murray**, M.B., B.Sc. Communicated by Prof. J. Rose Bradford, F.R.S.

In a previous communication the authors directed attention to the fact that the power of cell proliferation, which has been proved to occur in an epithelioma of the mouse (Jensen), is a phenomenon unparalleled in the mammalia. A mass of tumour, 16 lb. in weight, has been produced by artificially transplanting portions of the original growth and its descendants.

In seeking to throw light on this fact, the authors have studied carefully the phenomena which follow the transplantations of portions of the tissue to new sites, and have found that the tumours which arise are the genealogical descendants of the cells introduced. They have studied the growth of the tumours which arise at successive stages of twenty-four hours. In a tumour removed on the eighth day, and less than half a split pea in size, conjugation of resting nuclei has been observed. To take a specific case, the nuclei of two adjacent cells are continuous through the cell wall by a tube-like bridge, in the middle of which a strand of nucleolar substance with fusiform swellings in either cell is visible. The cells of this particular case are adjacent to the stroma, and close to the outer surface of the young tumour.